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(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD

(72)Inventor : KITAURA HIDEKI
YAMADA NOBORU

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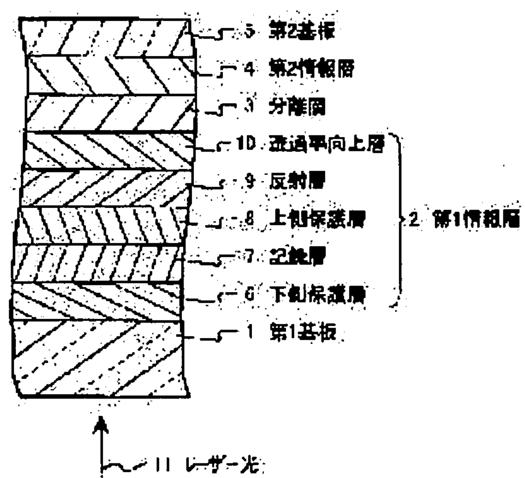
(54) OPTICAL INFORMATION RECORDING MEDIUM, METHOD FOR PRODUCING SAME, RECODING AND REPRODUCING METHOD AND RECORDING AND REPRODUCING EQUIPMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an optical information recording medium with plural information layers having a high C-N ratio in overwriting at high density and high linear velocity and a high erasure rate.

SOLUTION: A 1st information layer 2, a separation layer 3, a 2nd information layer 4 and a 2nd substrate 5 are formed in this order on a 1st substrate 1. The 1st information layer 2 is multilayer thin film with a lower protective layer 6, a recording layer 7, an upper protective layer 8, a reflecting layer 9 and a transmittance enhancing layer 10 from the 1st substrate 1 side. The reflectance of a mark part formed when the 1st information layer 2 is irradiated with converged laser light 11 from the 1st substrate 1 side in higher than that



of the base part with no formed mark and ≥40% of the light beam is allowed to reach the 2nd information layer 4 through the 1st information layer 2.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the thin film formed on the substrate by irradiating high energy beams, such as laser light, at the optical information record medium which can record and reproduce the high information signal of a signal quality, its manufacture approach, the record playback approach, and a record regenerative apparatus.
[0002]
[Description of the Prior Art] Conventionally the laser beam was irradiated at thin films, such as a chalcogen ingredient formed on the substrate, local heating was performed, it is known between the amorphous phases and crystal phases from which an optical constant (a refractive index n, an extinction coefficient k) differs by the difference among exposure conditions that it is possible to carry out a phase change, and development of the so-called phase change type adapting this phenomenon of optical information record medium has been performed.
[0003] In the optical information record medium of a phase change mold, it is possible by using only a single laser beam, becoming irregular according to an information signal between 2 level of a recording level and elimination level, and irradiating a laser output on a code track to record a new signal, eliminating the existing signal. This approach is advantageous to informational record at the point which unlike a magneto-optic recording etc. can simplify a head since the magnetic-circuit components are unnecessary, and the point that rewriting time amount can be shortened since record and elimination can carry out to coincidence further.
[0004] Evaporation of the recording layer at the time of using it in such optical information record media repeatedly, A recording layer prepares up and down by making into a protective layer the dielectric which was excellent in thermal resistance in order to prevent heat deformation of a substrate etc. Furthermore, the configuration which carried out the laminating of the four or more-layer ingredient thin film layer which prepared reflecting layers, such as a metallic material, for the purpose which make it easy to use incident light efficiently on the protective layer of a substrate and the opposite side, to raise a cooling rate, and to make it amorphous is common.
[0005] It is common to form a smaller mark by short-wavelength-izing of the light source which uses the optical information record medium of a phase change mold for record as a means to large-capacity [densification and]-ize, high NA(numerical aperture)-ization of an objective lens, etc., and to raise the linear density of the hoop direction on the substrate of a record mark and the track density of the direction of a path. Moreover, for the improvement in linear density, for the improvement in track density of the mark edge record which gives information, the land & groove record which uses as a recording track both lands between the groove which is the slot for laser light guidance prepared on the substrate, and its guide rail is proposed by the die length of a mark, respectively, and is introduced into it.
[0006] And two or more laminatings of the information layer in which still such record is possible are carried out through a detached core, and the layer recognition means and layer change means (Patent

Publication Heisei No. 505188 [ten to] official report etc.) for choosing any one of the record media (JP,9-212917,A, Patent Publication Heisei No. 505188 [ten to] official report, etc.) which doubled capacity, and such two or more of the information layers, and performing record playback are proposed.

[0007] Moreover, not only densification but raising an information processing rate, i.e., the rate of informational record playback, and high linear-velocity-ization which is made to rotate a disk at a high engine speed, and performs record playback importantly therefore also in the same radius location are also advanced for examination.

[0008] In such an optical information record medium, in order to acquire good and practical a signal quality and record reproducing characteristics, some technical problems occur, and the cure is taken.

[0009] First, in order to obtain big signal amplitude and a high C/N ratio, the reflection factor change between crystal-amorphous must be large. For that purpose, the recording layer to the laser beam of wavelength lambda sets the reflection factor of a crystal and the disk in the case of being amorphous to Rc and Ra, respectively, and it is required for the absolute value of reflection factor difference deltaR=Rc-Ra to be large.

[0010] Moreover, in order for melting to take the latent heat of fusion as a crystal by the case where they are the case where the substrate before record is amorphous, and a crystal in over-writing by the single beam, even if it irradiates the beam of the same power, the difference of attainment temperature will arise, and, for this reason, distortion of a mark configuration will arise in response to the effect of the signal before the over-write at the time of over-writing. Thereby, decline in the rate of elimination and increase of the error (jitter) of the time amount shaft orientations of a regenerative signal will take place. Effect becomes large, so that this phenomenon becomes so remarkable that it becomes high linear velocity and it becomes high density (3109 for example, Noboru Yamada, "Potential of germanium-Sb-Te Phase-Change Optical Disks for High-Data-Rate Recording", and Optical Data Storage '97, Proceedings of SPIE, Vol. 28 (1997)). In order to solve this technical problem, the approach of making equal attainment temperature of both at the time of irradiating the beam of the same power as the crystal section and the amorphous section is proposed (JP,1-149238,A etc.). In order that according to this approach the recording layer to the laser beam of wavelength lambda may set the absorption coefficient of a crystal and the recording layer in the case of being amorphous to Ac and Aa, respectively and absorption coefficient ratio Ac/Aa may compensate a part for the latent heat of fusion of the crystal section, it is required to be larger than at least 1 (Ac/Aa> 1).

[0011] In order to enlarge the absolute value of deltaR, there are two, the reflection factor reduction mold with which Rc>Ra, i.e., deltaR, takes a forward value, and the increment mold in a reflection factor with which Rc<Ra, i.e., deltaR, takes a negative value. In a reflection factor reduction mold, since it is easy to enlarge Rc, and the reflection factor used as the base can be made high and most Ra is made to 0, there is an advantage that contrast of a signal can be enlarged. However, in order to also enlarge Ac/Aa at coincidence, when one of whether a part of incident light is made to penetrate or it is made to absorb in addition to a recording layer is needed and incident light is used efficiently, it is disadvantageous in respect of the degree of freedom on an optical design. Since Ac/Aa also becomes large in the increment mold in a reflection factor at coincidence so that the absolute value of deltaR is enlarged, when it is not necessary to make a part of incident light penetrate, or to make it absorb in addition to a recording layer and incident light is used efficiently on the other hand, it is advantageous in respect of the degree of freedom on an optical design.

[0012] As an example of a configuration of the record medium of such an increment mold in a reflection factor, at least five layers, semi-permeable optical interference layers, such as Au, a bottom protective layer, a recording layer, a top protective layer, and a reflecting layer, are prepared on a substrate at this order, and the configurations (JP,7-78354,A, JP,7-105574,A, JP,7-262607,A, etc.) which enlarge the absolute value of deltaR with the increment mold in a reflection factor especially using the cross protection of the light by said optical interference layer are indicated.

[0013] By the way, the record medium equipped with two or more above information layers performs record playback to the 2nd information layer located in a back side with the light which penetrated the 1st information layer located in a near side, in view of a laser light incidence side. Therefore, high

permeability and the 2nd information layer are asked for high record sensibility and a high reflection factor at the 1st information layer.

[0014] The disk configuration used as the reflection factor reduction mold with which the 1st information layer does not have a reflecting layer, and the increment mold in a reflection factor with which the 2nd information layer prepared the translucent layer in the optical incidence side is also proposed to such a technical problem. By doing so, each the sensibility and the reflection factor of the permeability of |deltaR| of the 1st information layer and the 2nd information layer and Ac/Aa, and the 1st information layer and the 2nd information layer can be made high, and good record reproducing characteristics are acquired.

[0015]

[Problem(s) to be Solved by the Invention] However, according to an artificer's count, as the 1st information layer, the conclusion that it was [an optical design top] more advantageous to apply the increment mold record medium in a reflection factor was obtained from a viewpoint of making |deltaR| and Ac/Aa large to coincidence, like the above-mentioned. However, the conventional increment mold record medium in a reflection factor had the recording layer and/or the thick reflecting layer, and were those from which permeability is not obtained. [most] That is, the increment mold record medium in a reflection factor with high permeability is devised, and it is not shown that it is possible and effective to apply to the 1st information layer of a multilayer record medium.

[0016] Moreover, the densification by record playback with red laser light has arrived at the region of a limitation mostly. Then, the improvement in recording density by the smaller beam spot is being considered, using blue laser light as a means of new densification. It becomes a technical problem that a wavelength dependency is in the optical constant n, i.e., the refractive index, and extinction coefficient k of a recording layer here. For example, in a red light wave length region, although n and k have a value larger than the value in an amorphous state in a crystallized state, n of an amorphous state will be larger than n of a crystallized state in a blue glow wavelength region, and, as for germanium-Sb-Te which is the most typical record ingredient, size will reverse them. Thereby, especially with the above-mentioned configuration, it becomes difficult to enlarge each of |deltaR|, Ac/Aa, and permeability in the 1st information layer. Not only as for a blue glow wavelength region but other ingredients, rather than n of an amorphous state, n of a crystallized state has the same technical problem, when large.

[0017] this invention -- the above-mentioned technical problem -- solving -- high density and quantity -- each of C/N ratios in linear velocity over-writing and rates of elimination aims at offering the optical information record medium equipped with two or more high information layers. Moreover, it aims at offering the manufacture approach of this optical information ******, the record playback approach of this optical information record medium, and a record regenerative apparatus.

[0018]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the optical information record medium of this invention On the 1st substrate, it has the 1st information layer, a detached core, the 2nd information layer, and the 2nd substrate at least at this order. Said 1st information layer at least sequentially from the side near said 1st substrate A bottom protective layer, It consists of a multilayered film which equipped this order with the recording layer and top protective layer which change with the exposures of a light beam reversibly between two or more detectable different conditions optically. The reflection factor in the field (mark field) which condensed said light beam which carried out incidence from said 1st substrate side in said 1st information layer, and formed the mark When said light beam which it was higher than the reflection factor in the field (space area) which does not form said mark, and carried out incidence from said 1st substrate side is condensed in said 2nd information layer It is characterized by the percentage of said light beam which penetrates said 1st information layer and reaches said 2nd information layer being 40% or more.

[0019] In the above-mentioned optical information record medium, it is desirable that the field in which the mark was formed is an amorphous state and the field which does not form the mark is a crystallized state. Moreover, in the above-mentioned optical information record medium, it is desirable that the wavelength of a light beam is 500nm or less. Moreover, it is desirable that the 1st information layer

equips the detached core side of a top protective layer with the reflecting layer further. Moreover, it is desirable that the 1st information layer equips the detached core side of a reflecting layer with the improvement layer in permeability further. Moreover, it is desirable that the 1st information layer equips further with the volume phase at least one side chosen from the interface between a bottom protective layer and a recording layer and the interface between a recording layer and a top protective layer.

[0020] Moreover, in the above-mentioned optical information record medium, it is desirable that the thickness of a recording layer is 3nm or more 10nm or less. Moreover, it is desirable that a recording layer contains germanium, Sb, and Te at least. Moreover, when atomic ratio germanium:Sb:Te of germanium, Sb, and Te which are contained in a recording layer is displayed as x:y:z (x+y+z=1), it is desirable that it is 0.10<=x<=0.50 and 0.40<=z<=0.60.

[0021] In order to attain the above-mentioned purpose, moreover, the manufacture approach of the optical information record medium of this invention On the 1st substrate, it has the 1st information layer, a detached core, the 2nd information layer, and the 2nd substrate at least at this order. Said 1st information layer at least sequentially from the side near said 1st substrate A bottom protective layer, It consists of a multilayered film which equipped this order with the recording layer and top protective layer which change with the exposures of a light beam reversibly between two or more detectable different conditions optically. The reflection factor in the field which condensed said light beam which carried out incidence from said 1st substrate side in said 1st information layer, and formed the mark When said light beam which it was higher than the reflection factor of the field which does not form said mark, and carried out incidence from said 1st substrate side is condensed in said 2nd information layer It is the manufacture approach of an optical information record medium that the percentage of said light beam which penetrates said 1st information layer and reaches said 2nd information layer is 40% or more. The membrane formation process which carries out said 1st information layer on said 1st substrate, and carries out the laminating of said 2nd information layer on said 2nd substrate, respectively, The initialization process made into the initial state which can record said 1st information layer and said 2nd information layer, It is characterized by forming said recording layer in said membrane formation process including the adhesion process which sticks said 1st substrate and said 2nd substrate through said detached core so that said 1st information layer and said 2nd information layer may face each other in the ambient atmosphere which uses rare gas and nitrogen as an indispensable component.

[0022] In order to attain the above-mentioned purpose, moreover, the record playback approach of the optical information record medium of this invention On the 1st substrate, it has the 1st information layer, a detached core, the 2nd information layer, and the 2nd substrate at least at this order. Said 1st information layer at least sequentially from the side near said 1st substrate A bottom protective layer, It consists of a multilayered film which equipped this order with the recording layer and top protective layer which change with the exposures of a light beam reversibly between two or more detectable different conditions optically. The reflection factor in the field which condensed said light beam which carried out incidence from said 1st substrate side in said 1st information layer, and formed the mark When said light beam which it was higher than the reflection factor in the field which does not form said mark, and carried out incidence from said 1st substrate side is condensed in said 2nd information layer It is the record playback approach of an optical information record medium that the percentage of said light beam which penetrates said 1st information layer and reaches said 2nd information layer is 40% or more. The wavelength of said light beam is 500nm or less, and it is characterized by performing informational record and playback by forming and detecting said mark by said light beam which carried out incidence to said 1st information layer and said 2nd information layer from said 1st substrate side.

[0023] In order to attain the above-mentioned purpose, at least on the 1st substrate Moreover, the 1st information layer, This order is equipped with a detached core, the 2nd information layer, and the 2nd substrate. Said 1st information layer It consists of a multilayered film which equipped this order with the bottom protective layer, the recording layer which changes with the exposures of a light beam reversibly between two or more detectable different conditions optically, and the top protective layer at least sequentially from the side near said 1st substrate. The reflection factor in the field which condensed said

light beam which carried out incidence from said 1st substrate side in said 1st information layer, and formed the mark When said light beam which it was higher than the reflection factor in the field which does not form said mark, and carried out incidence from said 1st substrate side is condensed in said 2nd information layer The light source which the rate of said light beam which penetrates said 1st information layer and reaches said 2nd information layer is [light source] the record regenerative apparatus of the optical information record medium which is 40% or more, and generates said light beam with a wavelength of 500nm or less, It is characterized by having a layer recognition means and a layer change means for said light beam which carried out incidence to said 1st information layer and said 2nd information layer from said 1st substrate side forming and detecting said mark.

[0024]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained using a drawing. With one gestalt of the optical information record medium of this invention, the 1st information layer 2, a detached core 3, the 2nd information layer 4, and the 2nd substrate 5 are formed on the 1st substrate 1 at this order as shown in drawing 1 . The 1st information layer 2 is the multilayered film with which the laminating of the bottom protective layer 6, a recording layer 7, the top protective layer 8, a reflecting layer 9, and the improvement layer 10 in permeability was carried out to order from the side near the 1st substrate 1. However, a reflecting layer 9 and the improvement layer 10 in permeability are not indispensable layers. By this optical recording information medium, record playback of the information is carried out by irradiating the laser light 11 from the 1st substrate 1 side to both the 1st information layer 2 and the 2nd information layer 4.

[0025] As an ingredient of the 1st substrate 1, polycarbonate resin, polymethylmethacrylate resin, polyolefin resin, ATON resin, glass, etc. can be used. Although especially the thickness of the 1st substrate 1 is not limited, its about 0.05-2.0mm is desirable. Moreover, it is desirable that the shape of a spiral and the concentric circular slot for tracking of the laser light 11 is established in the front face of the side which forms the film of the 1st substrate 1.

[0026] the 1st information layer 2 -- the 2nd information layer 4 -- receiving -- sufficient power -- record -- carrying out -- in addition -- and permeability must be high in order to obtain sufficient amount of reflected lights. In order to go and come back to the 1st information layer 2 (that is, it penetrates twice), when reproducing the 2nd information layer 4, the quantity of light of the laser light 11 will be decreased by the square of the permeability of the 1st information layer 2. In order to perform servo controls, such as focusing and tracking, to the 1st information layer 2 and the 2nd information layer 4, also at the lowest, 5% of reflection factor is required. Then, when the permeability of R1 and R2, and the 1st information layer 2 is set to T for the reflection factor of the 1st information layer 2 and the 2nd information layer 4, respectively, (1) R1 >=5% and (2) R2xT2 >=5% are needed. Since the rate of light absorption of the 2nd information layer 4 becomes small, and sensibility will worsen and will become insufficient [record power] if R2 is enlarged, a maximum of about 30% of R2 is a limitation. When it does so, in order to fill (2), an outline and T>=40% are needed.

[0027] Moreover, when recording on the 2nd information layer 4, before the laser light 11 reaches the 2nd information layer 4, it will penetrate the 1st information layer 2 once, and the power will decrease it. For example, about 15mW of the substantial record power of semiconductor laser with an available now wavelength of 660nm is a limitation. The greatest substantial record power which follows, for example, penetrates the 1st information layer 2 when the permeability of the 1st information layer 2 is 30%, 40%, and 50%, and reaches the 2nd information layer 4 is 4.5mW, 6.0mW, and 7.5mW, respectively. On the other hand, even if actually required record power is a high sensitivity record medium, at least 6mW is required for it.

[0028] if the above is taken into consideration -- record and playback -- the permeability of the 1st information layer 2 is more preferably [50% or more of] required at least 40% or more from any viewpoint. Although the above was the case of a red light wave length region, in the blue glow wavelength region, wavelength became short compared with the case of a red light wave length region, namely, since the energy per one photon became high, becoming recordable by about 2/3-time laser reinforcement lower was checked by experiment. However, since it is expected to become about 2/3

time, the permeability required of the 1st information layer 2 is comparable [compared with red light semiconductor laser, the limitation of the output of the blue glow semiconductor laser by which current development is carried out is also low, for example,] as the case of a red light wave length region also in a blue glow wavelength region after all. As mentioned above, the permeability of the 1st information layer 2 is made into 40% or more.
[0029] The bottom protective layer 6 and the top protective layer 8 are formed for the purpose, such as adjustment of the phase of the reflection factor, the absorption coefficient, and the reflected light to the 2nd substrate 5 at the time of laser light 11 exposure or control of the increment in a noise by the thermal damage on recording layer 7 grade, and the laser light 11. It is chemically [as an ingredient of these protective layers / physically and] stable, the melting point and softening temperature are higher than the melting point of a recording layer 7, and the ingredient of a recording layer 7 and the ingredient which does not carry out phase dissolution are desirable. Specifically Y, Ce, Ti, Zr, Nb, Ta, Co, Zn, aluminum, Oxides, such as Si, germanium, Sn, Pb, Sb, Bi, and Te, Ti, Zr, Nb, Ta, Cr, Mo, W, B, aluminum, Ga, In, Si, germanium, Nitrides, such as Sn and Pb, Ti, Zr, Nb, Ta, Cr, Mo, W, The ingredient according to the dielectric or dielectric which consists of simple substances, such as fluorides, such as sulfides, such as carbide, such as Si, and Zn, Cd, a selenide or a telluride, and Mg, calcium, and C, Si, germanium, or such mixture can be used. An ingredient different if needed may be used for the bottom protective layer 6 and the top protective layer 8, and the same ingredient can also be used for them.
[0030] It is desirable to use the ingredient from which the optical constant (a refractive index n, an extinction coefficient k) changes by irradiating the laser light 11 as a recording layer 7. For example, the alloy system which uses as a principal component the chalcogenide which uses Te and Se as the base, for example, germanium-Sb-Te, germanium-Te, Pd-germanium-Sb-Te, In-Sb-Te, Sb-Te, Ag-In-Sb-Te, germanium-Sb-Bi-Te, germanium-Sb-Se-Te, germanium-Sn-Te, germanium-Sn-Te-Au, germanium-Sb-Te-Cr, In-Se, In-Se-Co, etc., or the alloy system which added nitrogen, oxygen, etc. suitably to these can be used.
[0031] Since it will be quickly cooled if the thickness of a recording layer 7 is too thin, it is hard coming to crystallize, and permeability will become low if too thick. In order to investigate this limitation, each class of ZnS-SiO2 dielectric layer of 100nm of thickness, various germanium-Sb-Te recording layers of thickness, and ZnS-SiO2 dielectric layer of 100nm of thickness was formed by the sputtering method on the quartz substrate at this order, and signs that irradiated semiconductor laser pulsed light with a wavelength of 660nm, and a membranous condition changed to these samples were observed under the microscope. Consequently, although crystallization was not seen in less than 3nm of thickness however it might change the reinforcement and width of face of a pulse, the conditions to crystallize existed in 3nm or more of thickness. Moreover, as a result of calculating using the optical constant of below-mentioned germanium-Sb-Te, when it was about 10nm or less of thickness, it turned out that the configuration which can do permeability to 40% or more exists. When these things are taken into consideration, as for the thickness of a recording layer 7, it is desirable that it is [3nm or more] 10nm or less.
[0032] As a reflecting layer 9, incident light is used efficiently, a cooling rate is raised, and it is prepared for the purpose, such as making it easy to make it amorphous. As an ingredient of a reflecting layer 9, a simple substance metallic material with high thermal conductivity, such as aluminum, Au, Ag, and Cu, or one or more elements of these can be used as a principal component, and alloy ingredients which added other elements suitably for damp-proof improvement or adjustment of thermal conductivity, such as aluminum-Cr, aluminum-Ti, Ag-Pd, Ag-Pd-Cu, and Ag-Pd-Ti, can be used. 0.5 or less and since it is low, especially as for the ingredient of Ag system, a refractive index n can suppress light absorption small also in a blue glow wavelength region. For this reason, it is the ingredient desirable as a reflecting layer of the 1st information layer with which high permeability is demanded. However, even if there is no cooling effect of a reflecting layer 9, it may sufficiently be easy to make it amorphous with the presentation of record conditions, such as linear velocity, or a recording layer 7 etc. In such a case, in order to enlarge permeability more, a reflecting layer 9 may omit.

[0033] It is prepared in order to raise the degree of freedom on the optical design of reconciling high |deltaR| and high Ac/Aa, and high permeability as an improvement layer 10 in permeability. as the ingredient of the improvement layer 10 in permeability -- the difference of a refractive index with a reflecting layer 9 -- large (0.5 or more [Preferably] still more preferably 1.0 or more refractive-index differences) -- transparence or abbreviation -- a transparent ingredient is desirable. For example, in the case of an ingredient with a reflecting layer 9 small [the refractive index of Ag alloy etc.], a dielectric or semiconductor materials with a high (a refractive index is 2.0 or more still more preferably 1.5 or more preferably) refractive index, such as TiO2, Si, and SiC, can be used. If permeability can be made high but compared with the case with the same thickness of the recording layer 7 which has light absorption by forming such an improvement layer 10 in permeability, and a reflecting layer 9 where there is no improvement layer 10 in permeability and permeability is conversely made the same, part |deltaR| and Ac/Aa can be enlarged.
[0034] In order to perform record playback with the laser light 11 as an ingredient of a detached core 3 to each of the 1st information layer 2 and the 2nd information layer 4, in the wavelength lambda of the laser light 11, it is transparent, and a heat-resistant and adhesive high ingredient is desirable. Specifically, adhesion resin, such as ultraviolet-rays hardenability resin, a double-sided tape, a dielectric film, etc. can be used. Moreover, in case record playback is performed to either the 1st information layer 2 or the 2nd information layer 4, in order to avoid that the signaling information currently recorded on another side leaks, the thickness of a detached core 3 it is more than the more than depth of focus, for example, 2 micrometers, -- required -- in addition -- and it is desirable that the sum total with base material thickness is less than within the limits of base material thickness tolerance, for example, 100 micrometers, so that the laser light 11 can be condensed in both the 1st information layer 2 and the 2nd information layer 4.
[0035] Like the 1st information layer 2, although the 2nd information layer 4 should just be an information layer which can carry out record playback with the laser light 11, it is advantageous on manufacture to have changed the thickness of each class suitably, for example using the same ingredient as the 1st information layer 2. however -- the laser light 11 which penetrated and decreased the 1st information layer 2 -- enough -- recordable -- in addition -- and it is necessary to consider as a configuration with high record sensibility and reflection factor so that sufficient amount of reflected lights may be obtained
[0036] Although the same ingredient as the 1st substrate 1 may be used as an ingredient of the 2nd substrate 5, the ingredient which is not transparent may be used and the reverse of the 1st substrate 1 is [the shape of the quality of the material, thickness, and a quirk may differ from each other, and] sufficient as the direction of a spiral. Moreover, it is also possible to form the guide rail for 2nd information layer 4 in the front face by the side of the 2nd information layer 4 of a detached core 3 by 2P law. In this case, the 2nd substrate 5 may be a flat surface which does not have a slot, although a slot may be shown in the front face by the side of the 2nd information layer 4. The 2nd substrate 5 can also do things sticking on the 2nd information layer 4 using adhesives etc., or forms a direct overcoat resin layer, and is good also as the 2nd substrate.
[0037] Moreover, as shown in drawing 2 R> 2, the optical information record medium of this invention is the purpose of preventing property degradation by the counter diffusion of the atom in the interface at the time of repeat record, and can form a volume phase 20 in the interface of either between the bottom protective layer 6 and a recording layer 7 and between a recording layer 7 and the top protective layer 8 and both. Of course, the recording layer of the 2nd information layer 4 may be adjoined, and the same volume phase may be prepared. Although some dielectric materials which play the role as a volume phase in the ingredient which can be used as the bottom protective layer 6 and a top protective layer 8 exist, especially the ingredient that uses a nitride, an oxide, carbide, or such mixture, such as germanium, Si, aluminum, and Cr, as a principal component is suitable.
[0038] Hereafter, an optical design and optical property of the optical information record medium of this invention are explained. If the refractive index, the extinction coefficient, and thickness of an ingredient of each class are decided about multilayers, based on the law of conservation of energy, the

simultaneous equations of the light energy income and outgo in a field side can be stood to all interfaces, and the reflection factor to the light beam as the whole multilayers which carries out incidence, permeability, and the absorption coefficient of each class can be searched for by solving this (Iwanami Shoten written by Kubota extensive "wave optics", 1971, etc.). Optical count in case the wavelength of laser light is 405nm and 660nm was performed using this technique about the 1st information layer 2 which consists of each class of the ingredient shown in (Table 1), a refractive index n, and an extinction coefficient k.

[0039]

[Table 1]

層	材料	波長660nm		波長405nm	
		n	k	n	k
分離層	紫外線硬化性樹脂	1.6	0.0	1.6	0.0
反射層	Ag-Pd-Cu	0.3	4.0	0.3	2.0
上側保護層	ZnS-Si02	2.1	0.0	2.2	0.0
記録層	Ge-Sb-Te(結晶)	4.4	4.0	1.8	3.2
	Ge-Sb-Te(非晶質)	4.2	1.5	3.0	2.0
下側保護層	ZnS-Si02	2.1	0.0	2.2	0.0
基板	ポリカーボネイト	1.6	0.0	1.6	0.0

[0040] The thickness of each class is changed to arbitration and an average transmission coefficient Tave shows [50% or more and |deltaR|] a result in case Ac/Aa serves as maximum in 5% or more of range in (Table 2).

[0041]

[Table 2]

	反射率減少型		反射率増加型	
	波長660nm	波長405nm	波長660nm	波長405nm
Ac/Aa	1.20	0.85	1.50	1.10
ΔR	12%	5%	15%	7%
Tave	50%	50%	50%	50%

[0042] Since the surface ratio of the tooth-space part (crystal) and mark part (amorphous) in the front face of the recording layer [finishing / record] 7 was about 4:1, the recording layer to the laser beam which carries out incidence assumed the average transmission coefficients Tave to be Tave= (4 Tc+Ta) / 5 here by setting the permeability of a crystal and the disk in the case of being amorphous to Tc and Ta, respectively. Moreover, each thickness of a recording layer 7 of the configuration from which the result of (Table 2) was obtained was 6nm, and the case of the increment mold in a reflection factor was [each case / each of / of 10nm and a reflection factor reduction mold of the thickness of a reflecting layer] 5nm. According to (Table 2), Ac/Aa of a reflection factor reduction mold is as large as 1.20 on the wavelength of 660nm of a red wavelength field, but on the wavelength of 405nm of a blue wavelength field, the problem of the rate fall of elimination and jitter increase becomes remarkable [Ac/Aa]. [in / as mentioned above / it is as small as 0.85 and / high linear velocity and high-density over-writing] On the other hand, Ac/Aa is [in / with the increment mold in a reflection factor / the wavelength of 405nm] as large as 1.10.

[0043] Since Rc is lower than Ra, generally Tc is higher than Ta, and since Rc is higher than Ra in a reflection factor reduction mold, generally Tc is conversely lower in the increment mold in a reflection factor, than Ta. Since the area in a recording layer has the crystal (non-recording part) larger than an

amorphous substance (record mark part) (for example, there is a difference which is about 4 times). The way of the increment mold in a reflection factor with Tc higher than Ta tends to enlarge Tave. In other words, thickness of a reflecting layer can be thickened under the conditions that the increment mold in a reflection factor of Tave is the same. For example, the range of the thickness of a reflecting layer where 40% or more of Tave is obtained was 7nm or less in 13nm or less and a reflection factor reduction mold in the increment mold in a reflection factor, when the thickness of a recording layer was 6nm on the wavelength of 405nm as mentioned above.

[0044] If thickness of a reflecting layer is thickened, the cooling rate of a recording layer will improve. Therefore, a recording layer can be easily made amorphous. Thick-film-izing of a reflecting layer is advantageous also from a viewpoint of formation of the record mark to which the configuration was ready.

[0045] thus -- the increment mold in a reflection factor -- a blue glow wavelength region -- also setting -- high linear velocity and high-density over-writing -- it can respond -- in addition -- and high permeability required as the 1st information layer is also obtained. Although this is as a result of [of only two wavelength (660nm and 405nm)] count, the optical constant of each class is changing according to wavelength, and although especially the recording layer 7 is based also on an ingredient, 0.8 or less are the ratio to n with n of a crystal about more nearly amorphous notably [the inclination for n of a crystal to become smaller than amorphous n by the short wavelength side] than the wavelength of 500nm in many cases. Therefore, it is a case with a wavelength of 500nm or less that the increment mold in a reflection factor especially becomes advantageous rather than a reflection factor reduction mold in an optical property.

[0046] Hereafter, the manufacture approach of the optical information record medium of this invention is explained. The manufacture approach of the optical information record medium of this invention consists of a membrane formation process, an overcoat process, an initialization process, and an adhesion process, and performs each process in this order fundamentally.

[0047] The 2nd information layer 4 is formed, respectively on the front face where the 1st information layer 2 was formed in the guide rail of the 2nd substrate 5 as a membrane formation process on the front face in which the guide rail of the 1st substrate 1 was prepared. the 1st information layer 2 and the 2nd information layer 4 -- for example, vacuum evaporation technique, the sputtering method, the ion plating method, and CVD (Chemical Vapor Deposition) -- law and MBE (Molecular Beam Epitaxy) -- it can form by the usual gaseous-phase thin film depositing methods, such as law. From viewpoints, such as quality of a membrane formation rate, a manufacturing cost, and the film obtained, the sputtering method of balance is the best especially. Although membranes are generally formed with a sink in inert gas in the chamber of a high vacuum condition, membranes may be formed in that case, making oxygen, nitrogen, etc. mix. It may be effective in O atom, N atom, etc. being able to mix into the film by this, being able to adjust the integrated state of a membranous property and each atom, and raising a repeat property, moisture resistance, etc. If nitrogen is made to mix in case a recording layer 7 is formed especially, it is advantageous at the point which can make small the refractive index n and/or extinction coefficient k of a recording layer 7, and it not only raises a repeat property etc. as mentioned above, but can make permeability high.

[0048] As an overcoat process, the spin coat of the UV resin etc. is carried out on the 1st information layer 2 and the 2nd information layer 4, ultraviolet-rays light is irradiated, and is stiffened, and an overcoat is given. However, this process can also be omitted when there is no possibility that the film may evaporate, in the case of the following initialization process.

[0049] As an initialization process, the whole surface is initialized namely, crystallized from a 1st substrate 1 and overcoat side by irradiating energy light, such as laser light, for example to the 1st information layer 2 and the 2nd information layer 4, respectively. However, when the transmission of the reflecting layer of the 2nd information layer is sufficiently high, after skipping a previous overcoat process and performing the following adhesion process previously, it is also possible to initialize namely, crystallize the whole surface from the 1st substrate 1 and 2nd substrate 5 side by irradiating energy light, such as laser light, for example to the 1st information layer 2 and the 2nd information layer

4, respectively.

[0050] As an adhesion process, the 1st information layer 2 and the 2nd information layer 4 oppose overcoat sides, and the 1st substrate 1 and the 2nd substrate 5 are stuck through a detached core 3. For example, ultraviolet-rays hardenability resin is applied on one of film surfaces, film surfaces can be opposed, both substrates can be pressurized and stuck, ultraviolet-rays light can be irradiated, and ultraviolet-rays hardenability resin can be stiffened.

[0051] Drawing 3 is the schematic diagram of the equipment for performing record and playback of the optical information record medium by this invention. Focusing of the laser light 11 which came out of laser diode 12 is carried out through a half mirror 13 and an objective lens 14 on the optical disk 16 which is rotating by the motor 15, and record and playback of an information signal are performed.

[0052] In case an information signal is recorded, the reinforcement of the laser light 11 is modulated using the pulse shape shown in drawing 4 . That is, when light is irradiated about the reinforcement of the laser light 11 at least, even if it irradiates sufficient power level P1 to carry out instant melting of the exposure section, and light, the exposure section is modulated between the power level P2 and P3 (however, P1>P2 >=P3 >=0) which cannot carry out instant melting. In addition, in order to modulate laser reinforcement as mentioned above, it is good to carry out by modulating the drive current of semiconductor laser, or it is possible also for using means, such as an electrooptical modulator and an acoustooptic modulator.

[0053] Although the single rectangular pulse of power level P1 is sufficient, when forming a long mark especially to the part which forms a mark, superfluous heat is excluded, it is the purpose which makes mark width of face homogeneity, and the record pulse train which consists of a train of two or more pulses modulated between power level P1, P2, and P3 is used. To the part which does not form a mark or eliminates a mark, it is kept constant with power level P2.

[0054] Furthermore, if the cooling section of power level P4 (however, P2>P4 >=0) is prepared immediately after two or more above-mentioned pulse trains, it is effective for being able to remove the heat of the mark back end part which is easy to become especially overheat, and preparing a mark configuration. On the contrary, in the mark front end part to which mark width of face tends to become thin that it is hard to make it amorphous, in order to arrange mark width of face with the back end, as shown in drawing 4 among said two or more pulse trains, only a top pulse can make the width of face large, or the power level can also be made higher than P1.

[0055] Moreover, if die length between each pulses of two or more above-mentioned pulse trains is fixed, since it can become irregular with single frequency, a modulation means can be simplified and it is advantageous.

[0056] Here, further, with each pattern, such as the die length of the next mark, a non-set arises in a mark edge location, and it sometimes becomes [the die length of a mark, the die length of the tooth space before and behind that, and] the cause of jitter increase. By the record playback approach of the optical information record medium of this invention, in order to prevent this and to improve a jitter, adjustment and compensation of the location or die length of each pulse of the above-mentioned pulse train can be done if needed so that an edge location may gather for every pattern.

[0057] In this way, in reproducing the recorded information signal, the laser light 11 of the power which is extent from which the information currently recorded on the 1st information layer 2 and the 2nd information layer 4 is not eliminated is irradiated at an optical disk 16, incidence of the reflected light is carried out to a photodetector 17, and it detects the amount change of reflected lights as a regenerative signal.

[0058]

[Example] Hereafter, this invention is not restricted by the following examples although an example explains this invention to a detail further.

[0059] As the 1st substrate, it consisted of polycarbonate resin and, in both 0.58mm in the diameter of 12cm, and thickness, the groove, and the land width, 0.4 micrometers and the groove depth used about 40nm thing. On the front face in which the groove of this 1st substrate was formed, as the 1st information layer ZnS-SiO2 (mole-ratio ZnS:SiO 2= 80:20) target is used. The bottom protective layer

of about 110nm of thickness, A germanium-Sb-Te (atomic ratio germanium:Sb:Te=29:21:50) target is used. The recording layer of about 6nm of thickness, The laminating of each class of the reflecting layer of about 10nm of thickness was carried out one by one by the sputtering method using the top protective layer of about 40nm of thickness, and the Ag-Pd-Cu (atomic ratio 98:1:1) target using ZnS-SiO2 (mole-ratio ZnS:SiO 2= 80:20) target.

[0060] On the front face in which the groove was formed, using the same substrate as the 2nd substrate moreover, as the 2nd information layer An Ag-Pd-Cu (atomic ratio 98:1:1) target is used. The reflecting layer of about 80nm of thickness, ZnS-SiO2 (mole-ratio ZnS:SiO 2= 80:20) target is used. The top protective layer of about 40nm of thickness, A germanium-Sb-Te (atomic ratio germanium:Sb:Te=29:21:50) target is used. The recording layer of about 10nm of thickness, The laminating of each class of the bottom protective layer of about 90nm of thickness was carried out one by one by the sputtering method using ZnS-SiO2 (mole-ratio ZnS:SiO 2= 80:20) target. Here, the 2nd information layer is seen from a laser light incidence side, and is carrying out the laminating to order from the layer in a reverse order, i.e., the back. Using the diameter of 10cm, and the about [thickness 6mm] target, all formed the mixed gas (N2 partial pressure of gas is about 5%) of Ar and N2 as sputtering gas, in order that Ar gas might be added except a recording layer and a recording layer might add N.

[0061] Next, the overcoat was given by carrying out the spin coat of the ultraviolet-rays hardenability resin on the film surface of the 1st information layer and the 2nd information layer, irradiating ultraviolet-rays light, and stiffening ultraviolet-rays hardenability resin.

[0062] Next, the whole surface was initialized namely, crystallized to the 1st information layer and 2 information layers by annealing with laser light from a 1st substrate and overcoat side, respectively.

[0063] Finally ultraviolet-rays hardenability resin was applied on the overcoat side of the 2nd information layer, the film surface of the 1st information layer is made to face, and both were pressurized and stuck, and ultraviolet-rays light was irradiated from the 1st substrate side, ultraviolet-rays hardenability resin was stiffened, and it considered as the detached core, and considered as the disk of one sheet which has two information layers (disk A).

[0064] Moreover, as another example of this invention, in the 1st information layer 2, the improvement layer in transmission of about 40nm of thickness was formed on the reflecting layer using TiO2 target, and if the point which set thickness of a top dielectric layer to 50nm was removed, the disk B as well as Disk A was produced.

[0065] Furthermore, Disk A and the disk C produced completely similarly were prepared as an example of a comparison except having set thickness of a bottom dielectric layer and a top dielectric layer to 60nm and 20nm, respectively.

[0066] The refractive index n and extinction coefficient k of an ingredient of each class are the same as what was shown in Table 1, and the optical property of Disk A (increment mold in a reflection factor) and Disk C (reflective reduction mold) of them is the same as that of what was shown in Table 2. In addition, the optical constants of TiO2 in the wavelength of 405nm for which it asked by observation were n= 2.7 and k= 0.0, and, according to the optical count performed like Disk A and Disk C, the values of Ac/Aa of Disk B, deltaR, and Tave were 1.20 or 10% and 50%, respectively.

[0067] Mark edge record was performed for these disks on condition that linear velocity 5 m/s using the wavelength of 405nm, and the optical system of NA0.6, and the following measurement was carried out. First, where it recorded 3T 9.7MHz signal and 11T 2.6MHz signal on the groove and the land 11 times by turns and 3T signal is recorded, this truck was reproduced, and that C/N ratio and the rate of elimination were measured with the spectrum analyzer. The rate of elimination measured here was made into the ratio of the amplitude of the amplitude of the rate of effective elimination, i.e., 3T signal, and 11T residual signal.

[0068] In the case of 3T signal, the laser modulated wave form at the time of recording a signal made it the single rectangular pulse of 51.3ns of pulse width (power level P1), and, in the case of 11T signal, it was made into the pulse train (power level P1) which consists of nine pulses, and the head is 51.3ns, all of 2nd henceforth are the pulse width for 17.1ns, and width of face between each pulse (power level P3)

was also set to 17.1ns. In the part which does not record a mark, it considered as the continuation light of power level P2. Power level determined, and as a direction, when the 1st information layer was reproduced and 1.5 times of the lower limit of the power to which the C/N ratio exceeds 45dB when the record power level P1 records 3T signal, and power level P2 and P3 reproduced 1.0mW and the 2nd information layer, they set to 1.5mW the median of the power range where the rate of elimination exceeds 15dB, and playback power level. The result of having performed the above-mentioned measurement is shown in Table 3.

[0069]

[Table 3]

	ディスクA		ディスクB		ディスクC	
	グルーブ	ランド	グルーブ	ランド	グルーブ	ランド
C/N比	50dB	48dB	50dB	50dB	48dB	47dB
消去率	22dB	21dB	26dB	24dB	14dB	12dB

[0070] The C/N ratio of 48dB or more and the rate of elimination of 20dB or more were obtained, and the 1st information layer of the disk A of this example and Disk B was sufficient good signal quality to use as a practical record medium. Especially, by Disk B, the about 25dB elimination ratio still higher than Disk A is obtained, and the effectiveness that the value of Ac/Aa is larger is reflected. On the other hand, the elimination ratio was as low as about 13dB, and its 1st information layer of the disk C of the example of a comparison was inadequate as a practical record medium, although just about 48dB just of C/N ratios was obtained.

[0071]

[Effect of the Invention] according to [as explained above] this invention -- high density and quantity -- the optical information record medium with which each of C/N ratios in linear velocity over-writing and rates of elimination was equipped with two or more high information layers can be offered.

[Translation done.]